UNMET HIV TREATMENT NEEDS TO PREVENT VERTICAL TRANSMISSION AMOMG FEMALE SEX WORKERS IN LESOTHO

By

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ABSTRACT

Background: Despite considerable advances made to increase the accessibility of non-barrier contraceptives across Sub-Saharan Africa, their use continues to be constrained within the region. Within the high HIV burden environment in Sub-Saharan Africa including Lesotho, a low uptake of non-barrier contraceptives increases the risk of the risk of unwanted pregnancies and vertical transmission of HIV in the absence of continued engagement in HIV care. These risks are further amplified among Female Sex Workers may also be less likely to consistently engage in health facilities during antenatal and postnatal periods. Therefore, in these analyses we assess contraceptive uptake among FSW and aim to assess the correlates of engagement in HIV care among FSW not using non-barrier methods of contraception and thus may be at increased risk for unplanned pregnancy and vertical transmission.

Methods: In 2014, 744 FSW were recruited through respondent driven sampling and administered a structured questionnaire and HIV testing across Maputsoe and Maseru, Lesotho. Robust Poisson regression was used to estimate prevalence ratios of correlates of engagement in HIV care among HIV-positive FSWs who were not using non-barrier contraceptive methods.

Results: In total, 287/744 (39%) FSW of reproductive age were living with HIV and not using HC/LARC methods; of these only 32% (92/287) were using ART. In multivariate analyses, each additional year of age was independently associated with a 6% increase in ART utilization [aPrR: 1.06 (1.04 to 1.08); p <0.001]. Consumption of five or more drinks of alcohol on a working night was inversely associated with ART

use. Having received HIV educational information in the past year was also positively associated with ART use [aPrR: 2.62 (1.25 to 5.46); p=0.010].

Conclusion: The inadequate uptake of modern contraceptive methods, and level of engagement in HIV care among HIV positive FSW provide further impetus to integrate reproductive health and sexual health services. Furthermore, providing HIV education tailored to key populations such as FSW, while simultaneously scaling up HIV testing and treatment services that engage and retain FSW mothers and expectant mothers is critical for the prevention of vertical transmission. Taken together, impactful PMTCT services are those that are successful in the prevention of vertical transmission during pre and post-natal periods, as well as in averting unwanted/mistimed pregnancies through the provision of effective contraceptive services.

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CHAPTER 1: INTRODUCTION

1.1 Background and conceptualization

Considerable advances have been made to increase the accessibility of modern contraceptive methods across Sub-Saharan Africa (SSA). However, their use continues to be constrained within the region despite an increasing desire for birth spacing and small families.[1] Within SSA's high HIV burden environment, a low uptake of effective contraceptive services increases the risk of unwanted pregnancies and vertical transmission of HIV in the absence of continued engagement in HIV care.[2,3] These risks are further amplified among female sex workers (FSW) who experience a very high burden of HIV and who may report pregnancy intentions with their non-paying partners challenging the use of non-barrier contraceptive methods. Moreover, there is limited consistent use of barrier contraceptive methods. Therefore, characterizing optimal strategies for the prevention of unplanned pregnancy and vertical transmission of HIV is important for female sex workers who may also be less likely to consistently engage in health facilities during antenatal and postnatal periods.[3]

1.2 Setting: The Kingdom of Lesotho

The Kingdom of Lesotho is a landlocked country in Southern Africa, with an area that is almost the size of the State of Maryland and a population of 2.1 million. [4,5]

The terrain being primarily mountainous, over 80% of the country is 1800 m above sea level. The presence of little arable land results in frequent food shortages, leaving the population dependent on external aid, and remittances from migrant workers. With over half of the population living below the poverty line, and 28.1% of its labor force unemployed, the country has experienced large-scale labor migrations to

surrounding South Africa to gain employment primarily in the mining or farming activities. Newer data suggests that increasingly, Lesotho women migrate to support their families gaining employment as domestic workers in South Africa.[6]

Adding to the socio-economic challenges of the Lesotho people, currently 23.4% of them live with HIV, making this the third largest generalized epidemic in the world. Estimates suggest that per year the country experiences about 19,000 new HIV infections and over 8,000 deaths due to AIDS.[7] The primary mode of HIV transmission is heterosexual sex, with a 2009 Modes of Transmissions report attributing this to 97% of all transmissions. The report also suggests that single and multiple partner relationships as the major drivers of the HIV epidemic.[8]

1.3 HIV Landscape in Lesotho

Southern African women experience a heightened burden of HIV compared to men in the region, as has been shown by surveillance and systematic review studies.[2,9] About 27% of Lesotho women aged 15-49 years live with HIV compared to 19% of age-matched men.[10] Within the African continent, FSW experience a higher burden of HIV with pooled prevalence estimates of 36.9% (95% CI 36.2- 37.5) compared to 7.4% among women in the general population.[11] Estimates of HIV among FSW in Southern Africa range from 70% in Malawi, to 46.4% in neighboring Johannesburg, South Africa, making FSW a high-risk group for HIV acquisition.[11,12]

A series of factors interact with one another to increase the HIV acquisition risks among FSW. The Modified Social Ecological Model proposes that 5 levels of risk factors, and their interactions along a porous continuum influences HIV acquisition: individual level risk behaviors, social and sexual networks, community perceptions, existing public policy, and stage of the HIV epidemic. The model is built on the

premise that individual level factors are a necessary but not sufficient condition for HIV acquisition, and therefore recognizing and addressing individual elements as well as social and structural elements may be instrumental to develop and guide new programs.[13]

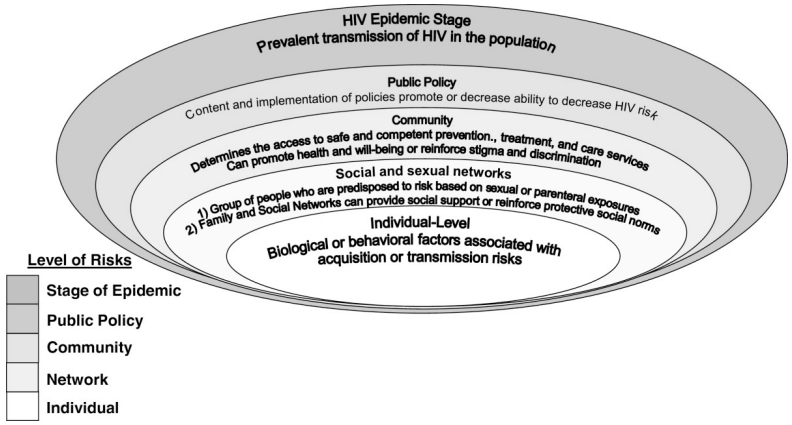


Figure 1: Modified Socio-Economic Model, Baral et al. 2013

On the individual level, biological and behavioral factors play a significant role in increasing the HIV acquisition risks of female sex workers. Women being receptive partners for vaginal and anal intercourse compounded by increased frequency of unprotected sexual encounters among female sex workers contribute to heightened HIV acquisition risks within this population.[14] However, unprotected sexual encounters are increasingly viewed as a consequence of negotiated interactions.[15] Among FSW, the difficulty in condom negotiation with paying and non-paying partners, and repeated exposures to stigma and violence within their social and sexual networks increases their chances of acquiring HIV.[14]

In the context of Lesotho, while 25% of men and 7% of women reported multiple sexual partners, only 66% of men and 54% of women with multiple sexual partners reported condom use at last sex in their demographic health survey in 2014, indicating the occurrence of condomless sex in the community.[16] Sexual violence was also

commonly reported in Lesotho with 22% of the women respondents in the SHARP study reported to ever have been physically forced to have sex, and a further 13% of them reported experiences of attempted forced sex.[17]

On a community level, stigma and discrimination associated with sex-work compounded by an HIV diagnosis limits engagement in health services among female sex workers. While there is limited data on the specific structural barriers experienced by FSW in Lesotho specifically, this has been documented in other settings and has been shown to impede healthcare engagement. From a legal framework, sex-work is illegal in Lesotho.[18] Historically, unsupportive legal environments have prevented the delivery of healthcare services that meet the needs of the population, and inadvertently ostracize the populations that need these services. [14]

The HIV care continuum has been employed in several settings as a critical step to assess current programming efforts and future program needs. Quantifying the elements of the continuum can help identify hurdles on the path to achieve viral suppression within a population. The most recent Country Operation Report issued in 2015 estimated that by the end of 2014, there were 297,000 people living with HIV, of which 205,699 were linked to care, and 106,384 were on ART. These losses in the cascade could be attributed to ART initiation based on CD4/ WHO staging in that period. The 2015 Country Operation Report provided estimates of the FSW population size and projected HIV prevalence estimates, however care continuum indicator estimates among FSW in Lesotho are unavailable.[19]

1.4 Reproductive Health Landscape in Lesotho

Attainment of safe motherhood outcomes for women in Lesotho remains a challenge due to traditional factors such as poverty, weaknesses across the health systems, and of the high national prevalence of HIV/AIDS.[20] While fertility rates have been

decreasing in the past decade in Lesotho, the current total fertility rate in the country is 3.3 births/woman.[16] Within the context of Lesotho's fertility rate and persistent HIV epidemic, it therefore becomes critical to address mother-to-child transmission risks faced by Lesotho women.

The second component in WHO's four-pronged comprehensive approach to prevention of mother-to-child transmission of HIV (PMTCT) lays emphasis on preventing unintended pregnancies through meeting the family planning needs of women living with HIV.[21] In a national survey conducted in Lesotho, only 60% of married women reported the use of non-barrier contraceptives. Of all births recorded between 2009-2013, about 49% were reported to have been wanted at the time; 29% of the births were reported to be mistimed and 22% were reported to be unwanted underscoring the need to increase the uptake of non-barrier contraceptive methods.[16]

The third component in WHO's four-pronged approach to PMTCT involves prevention of HIV transmission from HIV positive mothers to infants. This is enabled through HIV testing and counseling during antenatal period, provision of ART to infants (prophylaxis) and mothers (treatment) as well as adopting safer delivery practices to decrease the risk of infant exposure to HIV. The treatment extends to the postnatal period during which the mother and the infant continue to be in HIV care, and detailed information on breastfeeding is provided to reduce risk of HIV acquisition.[21] Therefore screening for HIV among pregnant women is an important step in linking both mother and child to ART and prevention services, thereby improving their likelihood of better outcomes.[22] Lesotho faces a major challenge in the uptake of PMTCT, with only 62% of all pregnant women attending ANC being tested for HIV, and only 64% of all diagnosed HIV positive engaged in HIV care,

emphasizing the need to strengthen HIV testing and counseling services during antenatal and postnatal periods to enable retention in HIV care.[19]

FSW across SSA continue to report high rates of pregnancies and poor reproductive health outcomes. While there is no available data on reproductive health outcomes of FSW in Lesotho, a systematic review assimilating the literature across low and middle-income countries in Africa suggests that sex work programs in Africa are usually of small scale, primarily directed toward research activities rather than population level programmatic activities. While existing programs often provide HIV testing and STI related care, they often fail to address reproductive needs of FSW.[23] However, it is important to recognize that FSW like all women have reproductive needs and pregnancy desires, although complicated as they often vary by partner type. More specifically, FSW may intend on pregnancies with their non-paying partner, but not with their clients challenging the use of non-barrier, long-acting contraceptives.[3] Therefore, both of the above described pillars of the PMTCT approach – reducing unmet need for family planning and reducing transmission from mothers living with HIV to their children through HIV testing and treatment - are important in the context of meeting the reproductive needs of FSW living in a high HIV burden environment of Lesotho. Scaling up of contraceptive services and HIV/testing and counseling services could help decrease unwanted pregnancies and well as promptly engage women newly infected with HIV in care to address their PMTCT risks.[24, 18]

In this context, our goal was to investigate the vertical transmission risks in a cohort of HIV positive FSW that have an unmet need for effective contraceptive measures. To this end, our objectives were:

1) Characterize the risk profile of FSW with respect to barrier and non-barrier contraceptive use.
2) Delineate the HIV care continuum among FSW in Lesotho not using non-barrier contraceptive methods.
3) Identify determinants of engagement in HIV care among HIV positive female sex workers with not using non-barrier contraceptives, factoring in both the reproductive health landscape and the social/stigma landscape.

CHAPTER 2: METHODS

Between January and December 2014, a cross-sectional study among Female Sex Workers was conducted in two urban cities in Lesotho, Maputsoe and Maseru. The objective of this cross-sectional study was to determine the population size of FSW in each of the two cities, estimate HIV prevalence among FSW, as well as to characterize the demographics factors, sexual and reproductive health behaviors in this population. In addition, the goal was to determine the level and extent of stigma experienced by FSW using validated stigma metrics, assess FSW knowledge of HIV/STI's, as well as identify the HIV/STI prevention and treatment needs of FSW.[14]

2.1 Sampling Strategy

2.1.1 Respondent Driven Sampling (RDS)

RDS is a sampling method used to recruit hard to reach populations: populations we that know are smaller than the general population in size but for which there is no sampling frame and for which we are unable to easily identify and reach members due to stigma and discrimination. Primarily, a sample of persons identified to have the greatest degrees/connections within a population is recruited. Leveraging their access into these hard to reach populations, each individual in the initial sample, referred to as 'seeds' are given a set number of coupons to distribute to people within their network. A process of chain referral is initiated and continued with the goal of obtaining a sample of persons that are more representative of the true population as we move into each wave of recruitment, and in the process our sampling strategy approximates random sampling. Since respondents recruit peers, each participants'

contacts and their network size is documented and a mathematical model corrects for the non-random recruitment process during analysis.[25]

2.1.2 Seed selection

The study team chose all the seeds, and they met the inclusion criteria (listed below) as set by the study team. The seeds represented diverse demographics and were willing to promote the study. Each seed was given three coupons, and therefore could recruit a maximum of 3 participants.[14]

2.2 Inclusion criteria, recruitment and confidentiality of participants

Participants had to be assigned female at birth, at least 18 years old at study entry, and had to be able to provide informed consent in English or Sesotho. All participants had to have lived in Lesotho for a minimum of 3 months, and all persons except the seeds had to present a valid referral coupon. Eligible FSW had to report sex work as their primary source of income for the past 6 months. Informed consent was verbally obtained to maintain confidentiality, and upon consent, the interviewer signed the forms. No names were linked with the survey questionnaires or HIV test results, and persons were instead identified by unique identifier codes. Participants were offered though not required to receive their HIV test results; HIV test results were provided on site during the same visit. Everyone that completed the questionnaire and biological testing was reimbursed for their time (Lesotho Loti 20, approx. USD 2.60) & transport (Lesotho Loti 20, approx. USD 2.60). Participants also received HIV informational materials and were given male and female condoms. Finally, those who recruited others into the study received an addition LSL 20 per eligible participant recruited, and an additional LSL 26 as a reimbursement for transport when they came

to collect their recruiter reimbursement amount and also completed a post-recruitment questionnaire.

Questionnaires were interviewer-administered, and were completed in a private setting, with each interview lasting 30-45 mins. A trained nurse collected blood samples, and all staff were provided with sensitivity training and research ethics training to minimize psychological risks to the participants.

All study related hard copy documents were securely stored in locked cabinets contained within locked rooms, and electronic data were protected with strong passwords.[14]

2.3 Laboratory procedures

HIV testing was conducted according guidelines in Lesotho. Voluntary testing and counseling methods were used to test participants, which entailed a pre-test counseling, blood withdrawal and screening using a rapid test kit, and post test counseling. Samples that tested positive in the first rapid screening test were confirmed through a secondary rapid test. HIV positive participants were linked to appropriate treatment referrals/ government led health care centers.

Ethical approval was obtained from Population Services International Research Ethics Board, Health Research Ethics Committee of Lesotho, and the Johns Hopkins Bloomberg School of Public Health Research Ethics Committee.[14]

2.4 Data Analysis

2.4.1 Network Size

The network size of FSWs in both sites, Maputsoe and Maseru were determined using

the question: “Of the FSW you know, how many of them have you seen or talked to in the last three months?”

2.4.2 Analysis Population

HIV positive FSW that are of reproductive age are at high risk of vertical transmission, should they not be engaged in HIV care, and do not use modern contraceptive methods to prevent unwanted pregnancies. Therefore we sought to obtain a population of HIV positive women that are of reproductive age (18-49 years), who were not using effective contraceptive methods to prevent pregnancy. Effective contraceptive methods included methods that under typical use reliably decreased the risk of unplanned pregnancy, including hormonal contraceptive methods (oral pills, injectable methods and implants) and non-hormonal contraceptive methods such as intra-uterine devices. Women were defined to have an unmet contraceptive need if they were currently not employing any of the above-mentioned contraceptive tools. As we were interested in risks related to vertical HIV transmission, we restricted our analysis to HIV positive women with unmet contraceptive need.

HIV positive women with unmet contraceptive need that were eligible for ART according to the Lesotho National Guidelines in 2010 defining eligibility as having a CD4 count less than 350 cells/uL, and were taking treatment at the time of study were classified as women on ART. Those who reported non-use of ART regardless of eligibility based on CD4/ WHO staging, or not having had a previous HIV diagnosis were categorized as women not on ART.

2.4.3 Outcome definition

The main outcome of interest was engagement in HIV care during the time of study. This was measured by self-reported ART use at study visit.

2.4.4 Statistical Analysis

The two datasets from Maputsoe and Maseru were merged to conduct all analyses. All data were analyzed using STATA/SE version 14 for Macintosh Computers (StataCorp LP, College Stata, TX).[26] Continuous variables were compared using t-tests, and chi-squared tests were used to compare categorical variables. An alpha error of 0.05 was determined as the cut-off for all analysis unless mentioned otherwise.

2.4.5 Crude and RDS estimates

Crude and RDS adjusted estimates were obtained for demographic factors. Separate population weights were computed for each of the demographic factors. RDS adjusted estimates were calculated from these weights. The purpose of conducting RDS adjusted analysis was to account for homophily: or the tendency that participants would recruit people that are similar to them, and the variation in the network size (or degrees/connection) of each participant. Standard errors for RDS estimates were calculated using bootstrapping with 1000 repetitions.

2.4.6 Description of Risk factors

Risk factors for engagement in HIV care was considered based on *a priori* knowledge and hypothesized relationships based on the review of literature. Risk factors for engagement in HIV care from three categories were explored: Demographic characteristics, Reproductive and Sexual health factors and decisions, and Stigma and Mental Health Factors **(Fig 2)**. Age, monthly income, education, number of living children, and relationship status were demographic factors that were hypothesized to impact engagement in HIV care. Reproductive and sexual health factors were measured by indicators assessing future pregnancy intentions, as well as having received HIV related information. Indicators measuring depression, stigma

experienced in health care settings, stigma experienced from uniformed authorities because they sell sex, disclosure of HIV status to a partner, and disclosure of selling sex to health care workers were indicators for stigma and mental health influencing engagement in HIV care among FSW. We also assessed behavioral factors that may impact ART use such as alcohol consumption on a typical working day. Exploratory data analysis and findings from existing literature informed the way we modeled risk factors to ensure that our findings and inferences were relevant and comparable with other studies.

2.4.7 Modeling demographic characteristics

Age was categorized into four quartiles to reflect the age-distribution across age groups. Education was categorized into three categories: Persons who has no education or schooling, persons that had completed primary education and those that had completed at least up to secondary education. Monthly income was categorized into < USD 100, USD 100-200 and >USD 200. Conversion from Lesotho Loti to USD was based on the conversion rate as of June 2014 (10.03 Lesotho Loti to 1 USD).[27]Relationship Status was categorized into single, divorced/separated/widowed, or as married/cohabitating/currently in a relationship**.**

2.4.8 Contraception use among female sex workers in Lesotho

Barrier and non-barrier contraceptive use among FSW were characterized. Condom use by partner type i.e.: new client, regular client and non-paying partner were estimated. Since all FSW did not report nonpaying partners, an indicator was developed that categorized FSW into three categories: those who did not report a non-paying partner, those who reported a nonpaying partner and used condoms with them, and those reporting a nonpaying partner who did not use condoms with them. Usage

of effective non-barrier methods of contraception by type i.e.: Oral pills, Injectable, Intra-uterine device, implants and hysterectomy were estimated. The proportion that reported non-use of any of these four methods was also estimated.

2.4.9 Cascade of HIV care among female sex workers in Lesotho

The proportion of women engaged in each step of the care cascade was characterized in the total population of FSW that were included in our study, and among all FSW that faced an unmet need for effective contraceptive measures. This was constructed using Microsoft Excel for Mac 2011, version 14.5.8. All cascade measures except the proportion living with HIV were self-reported. The proportion living with HIV was determined using a site-administered HIV rapid test. FSW were considered ART eligible if they met the national guidelines detailing the CD4 count threshold for ART initiation. At the time of the study, ART was available to those that met the CD4 count of <350 cells/uL or WHO staging criteria.

2.4.10 Regression Model

A Poisson model with robust variance estimates was used to approximate the log binomial model, since the prevalence of the outcome exceeded 10% and the log binomial model failed to consistently converge. Crude and adjusted prevalence ratios (PR) estimated the association of risk factors with the current engagement in HIV care.

Modeling of the risk factors for analysis was based on variable distributions assessed using lowess plots and by how they were modeled in existing literature to ensure comparability of our findings.

Selection of variables for the final model was ultimately based on *a priori* knowledge from existing literature and statistical associations at the bivariate level. Bivariate

associations were included in the multivariate model at an alpha level of ≤0.1. Multivariate associations were determined to be statistically significant at an alpha level of 0.05.

2.4.11 Sensitivity analyses

A sensitivity analysis was conduced restricting the analysis population to FSW that previously reported an HIV diagnosis to assess if the correlates of engagement in HIV care were different among the population of women that was previously diagnosed with HIV.

CHAPTER 3: RESULTS

In total 744 FSW were enrolled in our study including 12 seeds in Maputsoe and 7 seeds in Maseru. A total of 344 FSW were recruited in Maputsoe and 410 were recruited from Maseru.

The maximum number of recruitment waves within any FSW network was 19, and the median number of waves was 6 (IQR 4-9). The median network size was 10 (IQR 6-20). Recruitment chains indicating HIV status are depicted in **Figure 3**.

3.1 Population Characteristics

The median age of all FSW was 25 years (IQR: 21-30), and the mean age was 26.8 years (standard deviation [sd] 7.21). FSW in Maseru were younger than FSW in Maputsoe. ($p < 0.001$). A majority (>90%) of the FSW in our total population had completed at least primary schooling. FSW did not differ by site in terms of education level completed. The monthly earnings of the FSW in our population, which included income from sex work and non-sex work activities, were above that of the international poverty line as set by the World Bank.[28] The mean average monthly income was USD 166.77 (sd 141.79); and FSW in the capital city of Maseru were more likely to earn a higher monthly income than those in Maputsoe. ($p<0.001$). About 70% of our population reported their relationship status as single; FSW in Maputsoe were more likely to report being single than FSW in Maseru ($p < 0.001$). Greater than 60% of the FSW reported motherhood (≥1 child), with FSW in Maseru more likely to report motherhood than FSW in Maputsoe ($p=0.001$). **(Table 1**).

3.2 Contraception use among female sex workers in Lesotho

FSW reported consistency in condom use, and 64.4% (n=441/685) of them reported consistent use with new clients. Consistency in condom use with regular clients was lower than that reported with new clients (p<0.001). 62.1% (n=459/739) of the FSW reported that they did not have a non-paying partner. 68.7% (n=190/279) of FSW with a non-paying partner reported consistent condom use with them.

Fifty four percent (n/N =397/729) of the FSW reported non-use of non-barrier contraceptive methods, with FSW in Maseru more likely to report its non-use than those in Maputsoe. Among those that reported the use of non-barrier methods of contraception, over 35% (n/N= 259/730) reported the use of injectable methods. FSW in Maputsoe were more likely to report the use of injectable than FSW in Maseru (p<0.001) (**Table 2).**

3.3 Cascade of HIV care among female sex workers with unmet need for effective contraception

The HIV care cascade was constructed among HIV positive FSW in Lesotho, and among all HIV positive female sex workers with unmet contraceptive need as a function of those living with HIV. 71.9% (n/N =535/744) of the FSW in our population were living with HIV, and 55.3% (n=296/535) of HIV positive FSW had an unmet need for effective contraceptive measures. Among those living with HIV, 90.1% (n/N=482/535) of the FSW reported having taken at least one HIV test prior to the one administered on the site. 53.7% (n/N =259/482) of those having had a prior HIV test had an unmet need for effective contraceptive measures. About 64.1 % (n/N =343/535) of FSW had been previously diagnosed with HIV prior to study participation; 53.3% (n/N =183/343) among them had an unmet need for effective

contraceptives. The biggest drop in the cascade was in the step of ART eligibility. 36.6% (n/N =196/535) of the FSW reported being ART eligible; and 55.61% (n/N =109/196) had an unmet need for effective contraceptives. Finally, 32.9% (n/N =176/535) reported that they were currently taking ART, and among these 54.5% (96/176) had an unmet need for effective contraceptive methods. 30% (n=105) of the women currently not on treatment reported that their CD4 count was the limiting factor behind ART initiation **(Figure 4)**.

3.4 Determinants of ART use among female sex workers with unmet need for effective contraceptive methods.

The determinants of ART use were assessed among reproductive aged women living with HIV who did not use contraception, and thus at risk of vertical transmission of HIV **(Table 3).** ART use was statistically significantly different between the two sites in the unadjusted analysis; however this did not hold true in the fully adjusted model.

For the demographic characteristics assessed, age remained a significant predictor in the unadjusted and adjusted analysis, with every year in age showing a 6% increased prevalence in ART use [aPR=1.06; 95% CI: 1.03 - 1.08]. Relationship status impacted ART use in our analysis, with FSW who reported being married, cohabitating or in a relationship being more likely to use ART than FSW reporting being single [aPR= 2.31; 95% CI: 1.13 - 4.69]. Number of children was positively associated with ART use in bivariate and multivariate analysis. FSW who reported having one child were more likely to use ART than those who did not report having children [aPR=2.04; 95% CI: 1.31 – 3.17]. Higher levels of education were negatively associated with ART use in our unadjusted and adjusted analysis; the prevalence of

ART use was 1.86 times more in those with no formal schooling compared to those that completed at least up to secondary education [aPR= 1.83; 95% CI: 1.13 - 2.95]. A similar trend was observed in those that reported having completed primary education [aPR=1.90; 95% CI: 1.28 - 2.82].

For behavioral characteristics as risk factors, alcohol use on a typical working day was significantly associated with ART use. The prevalence of ART use was 41% lower among female sex workers that reported consuming ≥5 drinks /day compared to those that reported not consuming alcohol [aPR: 0.59; 95% CI: 0.40 - 0.87]. Reporting 1-4 drinks /day was not statistically significantly associated with ART use [aPR=0.88; 95%: 0.55 - 1.40].

Among variables assessing reproductive health and sexual health factors and decisions, future pregnancy intentions was associated with ART use in the unadjusted analysis, it failed to retain its association with ART use in the adjusted analysis [aPR=1.42; 95% CI: 0.96 – 2.12]. However, having received HIV education/information was strongly associated with ART use [aPR= 2.62; 95% CI: 1.25 - 5.46].

Depressive symptoms score, was not found to be associated with ART use. Among the variables assessing stigma, ever having been incarcerated, disclosing sex work as their occupation to a health care worker, and avoiding health care in fear that someone may learn that they sell sex were not statistically significantly associated with ART use in the unadjusted analyses at the 0.1 alpha level and therefore was not included in the final adjusted model.

Disclosing HIV status to a non-paying partner was statistically significantly associated with ART use at the bivariate level, but this relationship was not maintained in the final adjusted analysis [Not disclosed vs. no non-paying partner: aPR= 0.24; 95%CI: 0.04 - 1.49]. The same trend was observed for other stigma factors such as afraid of attending to healthcare because of concern that someone may learn that they sell sex [aPR=0.76; 95% CI= 0.37 - 1.56], experience of physical abuse [aPR= 0.94; 95% CI: 0.61 - 1.43], and experience of harassment from police on account of being a sex worker [aPR=0.85; 95% CI: 0.54 - 1.36]. Having been denied healthcare was marginally associated with ART use, with the prevalence of ART use being higher among those who reported ever having been denied healthcare because they sell sex compared to those who did not report this [aPR= 2.52; 95% CI: 0.97 – 5.75].

3.5 Sensitivity Analysis

A sensitivity analysis was conducted among HIV positive female sex workers who were eligible for ART based on their CD4 count (Table 4). The results of the sensitivity analysis were similar to that of the primary analysis. However, we observed that within this population, FSW who reported having pregnancy intentions were more likely to use ART than those that did not [aPR: 1.50; 95% CI: 1.07 – 2.09].

CHAPTER 4: DISCUSSION

Our analyses underscore the need to integrate sexual and reproductive health services for HIV prevention among female sex workers residing in regions of high HIV prevalence. Overall, 54.5% of the women included in our study reported to face an unmet need for effective contraceptive methods, and 74.5% of these women were living with HIV. In the subset of reproductive age FSW facing an unmet contraceptive need and living with HIV, only 32.1% of them reported to be currently taking ART. The HIV care continuum estimates from this study were comparable to estimates available from other studies conducted among female sex workers in this region, highlighting poor healthcare engagement among this population.[29-31]

Findings from across the African continent and beyond have demonstrated that reproductive health services including uptake of contraceptive services is lacking among all FSW and non-FSW women.[30–34] Within SSA's high HIV burden environment, studies suggest that fertility desires continue to be high among women regardless of their HIV status.[35,36] Similar findings have been observed among FSW in this region, necessitating early diagnosis of HIV infection, and fostering engagement and retention in HIV care to subvert risks of vertical transmission that may occur through intended or unintended pregnancies as well as to optimize health outcomes for FSW.[24] In our study, 64.1% of all HIV positive FSW reported that they were previously diagnosed with HIV, but only 51.3% (n/N=176/343) of those previously diagnosed reported to be on treatment. Among reproductive age HIV positive FSW with unmet contraceptive needs a majority (67.9%) of them were not on ART. Future pregnancy intentions were also high among these women, with 42.1%

reporting future motherhood intentions, dictating the need to better understand and address unmet HIV treatment needs among FSW in low resource high HIV prevalence settings. Understanding and addressing the fertility and pregnancy needs of HIV infected women is critical, especially among FSW characterized by high rates of unprotected sex with multiple partners where the desire for additional children needs to be balanced with the risk of HIV and other sexually transmitted infection.

Among reproductive aged FSW with unmet contraceptive need, the single greatest loss in the HIV care cascade was at ART initiation, with approximately a third of those previously diagnosed lost between CD4 count and ART initiation. However, the updated Lesotho National guidelines mandate 'Test and Treat' regardless of CD4/WHO staging which will hopefully result in improved linkage to care and treatment outcomes among FSW, although gaps remain in HIV service delivery systems in Lesotho.[37] Lesotho continues to face a shortage of resources including HIV test kits and human resources that impede service delivery and engagement in HIV care.[7,19] In general within Sub-Saharan Africa including Lesotho, the lack of organized health systems and facilities, including impending possibilities of medication shortage may constrain both engagement and retention in HIV care.[20,38] In addition, other impediments such as HIV stigma and gender-based violence, which are documented to be of high prevalence in Lesotho, further deter participation in HIV care.[14,17]

We sought to ascertain the determinants of engagement in HIV care among reproductive aged HIV positive FSW not using non-barrier methods of contraception. Older FSW were more likely to be engaged in HIV care in our study, which is

consistent with other findings conducted in SSA.[30] Similarly, parity was associated with increased engagement in care and ART uptake, as has been found in other studies within SSA since antenatal care is often the chief entry point into HIV care among women.[24] The provision of ART as a part of PMTCT care package increases the likelihood of ART utilization.[39,40] In addition, being married compared to being single was positively associated with increased engagement in HIV care, as has been found within other studies in the literature.[41,42]

The inverse association between engagement in HIV care and education level is contrary to that observed in other studies, where education has commonly been reported as a facilitator of engagement in HIV services.[43,44] we are unable to explain this unexpected finding through this analyses. However, we hypothesize that this may be because of the association of education with unmeasured confounder(s) resulting in its net negative impact on engagement in HIV care within this cohort.

Individual level risk factors such as alcohol use were found to negatively impact ART use. Studies conducted within primary healthcare settings in South Africa have found that alcohol consumption not only impacts adherence to treatment, but drug-alcohol interactions may affect treatment success.[45] Furthermore, alcohol use has been associated with unsafe sexual practices such as inconsistent condom use, and HIV acquisition as well as transmission.[46,47] Therefore screening for alcohol use in HIV/STI treatment services, and linking identified persons to cessation services and rehabilitation centers that advocate harm reduction may help improve treatment outcomes.

Having received HIV based education was found to be positively associated with increased engagement in HIV care. In a study conducted in Burkina Faso, a tailored intervention package provided to FSW which included treatment adherence support and group education sessions increased treatment initiation.[48] Several other studies conducted in SSA have highlighted the enabling power of education, and its positive impact on HIV diagnosis, treatment initiation and retention in care.[49]

The results of our sensitivity analyses conducted among FSW that reported a previous diagnosis of HIV were similar to those observed in the primary analyses, supporting the robustness of the primary analysis. In the sensitivity analysis, those that reported future pregnancy intentions were 47% more likely to report engagement in HIV care, showing a statistically more robust finding. This further underscores the need to focus on HIV outcomes among women with high pregnancies intentions to monitor their risks of vertical transmission, while continuing to work towards effectively integrating reproductive and sexual health services to better meet the current needs of the population.[50]

Engaging FSW in HIV care upon HIV diagnosis is an important step for favorable outcomes, which has been the focus of our investigation. However, for long-term outcomes, it is important to consider factors that both promote and retain FSW in HIV care. While PMTCT programs are yet to be strengthened in Lesotho, other settings in SSA region have noted the success of impactful PMTCT programs in promoting engagement and retention in HIV care.[51] However, these settings have also noted several missed opportunities in retaining HIV positive women in the post-natal period. These can serve as useful lessons for Lesotho as they scale up their HIV care

services through PMTCT programs. The key to successful delivery of mother and child health services involves the integration of essential services to be provided for the mother and infant. An effective care package delivered during the post-natal period would include post natal examinations including vaccinations, medications and general developmental screening for the infant; barrier and non-barrier type contraceptive provision, family planning related counseling, HIV/STI related testing for the mother, and HIV treatment services for mother and infant depending on the status of the mother, and implications for breastfeeding depending on HIV status. However, within this setting they found that fragmentation of each of facilities resulted in the mothers having to wait for an additional consultation for other services either on the same day or in the next subsequent days, resulting in an expensive, arduous, and inefficient process both the mothers and heath-care workers.[51] Therefore, impactful PMTCT services are those that are successful in the prevention of vertical transmission during pre and post-natal periods, as well as in averting unwanted/mistimed pregnancies through the provision of effective contraceptive services.

Currently, HIV services in Lesotho are offered within a decentralized framework as recommended by the WHO guidelines. Several studies conducted in SSA have investigated the effect of complete or partial decentralizing of HIV services to better meet the needs of the population. While the most appropriate HIV service delivery models are context and country specific, it is important to clearly define roles and responsibilities across services whether PMTCT or HIV to ensure both engagement and retention in care.[49]

Several studies across SSA have independently assessed the factors impacting the use of effective contraceptive methods or ART services among female sex workers, and have hypothesized the risks of vertical transmission as a consequence.[1,31,35,49] However, the strength of this analyses lies in that this is the first analysis assessing the risks of vertical transmission conducted among a cohort of female sex workers with unmet contraceptive needs, thereby directly assessing the factors that impact engagement in care among the subset of FSW for which risk of mother-to-child transmission is highest. Furthermore, while Lesotho works toward scaling up of HIV services to meet the current recommendations of 'Test and Treat', our analyses may help identify other structural barriers and bottlenecks that could help guide program implementation and foster engagement and retention in HIV care in Lesotho.

Our study has several limitations including the possibility of information bias due to self-reported measures for contraception use, and care cascade outcomes except for HIV status, which was determined through an on-site HIV testing. We were also not able to collect viral load data. Another limitation could be our sampling technique, RDS, which leverages peer networks. It is possible that we oversampled populations that were already engaged in care, since peers are more likely to know and recruit people that are similar to them in characteristics. However, RDS is the sampling method that is most likely to reach populations not engaged in care through long recruitment waves. Finally, due to the cross-sectional nature of our study, casual associations with respect to ART use cannot be determined, which warrant longitudinal studies to assess this.

Overall, the inadequate uptake of effective contraceptive methods and level of engagement in HIV care among HIV positive FSW provide further impetus to integrate reproductive health and sexual health services. Furthermore, the increased frequencies of sexual encounters among this population heighten their risks of unplanned pregnancies and potential for vertical transmission. This necessitates the scaling-up of HIV testing and treatment programs, including training of relevant staff that are efficient in both engaging HIV positive FSW mothers and expectant mothers in care, and in retaining them in care through and beyond antenatal periods to ensure successful PMTCT interventions.

TABLES AND FIGURES

Table 1: Baseline Characteristics of FSW in Lesotho (n=744)

Variable	Total (n=744) % (n)	Maputsoe (n=334) Crude estimates % (n)	Maputsoe (n=334) RDS adjusted estimates % (BCI)	Maseru (n=410) Crude estimates % (n)	Maseru (n=410) RDS adjusted estimates % (BCI)
Age categories					
18-21 (1st quartile)	26.2 (194/744)	18.6 (62/334)	20.4 (15.2- 26.8)	32.2 (132/410)	36.2 (29.6 -43.3)
22-25 (2nd quartile)	27.2 (202/744)	22.4 (75/334)	20.9 (15.5- 27.5)	30.9 (127/410)	30.2 (24.2 – 36.9)
26-30 (3rd quartile)	23.5 (175/744)	24.9 (83/334)	26.4 (20.1- 33.8)	22.4 (92/410)	19.6 (14.9 – 25.3)
>30 (4th quartile)	23.2 (173/744)	34.1(114/334)	32.4 (26.2 – 39.3)	14.4 (59/410)	14.0 (9.6 – 20.0)
Education completed					
None	9.9 (74/742)	11.1 (37/333)	12.4 (8.2 – 18.3)	9.1 (37/409)	13.6 (8.8 -20.4)
Primary	49.6 368/742)	51.8(173/333)	55.2 (47.8 – 62.3)	47.7 (195/409)	46.7(39.8 -53.7)
>=Secondary	40.6(300/742)	37.1(124/333)	32.4 (26.2 – 39.4)	43.3 (178/409)	39.8(33.2- 46.7)
Monthly income earned, USD					
<$100	32.7 (243/743)	45.9 (151/333)	47.3 (40.1 – 54.7)	22.4 (92/410)	28.6 (22.0-36.2)
$100-$200	49.8 (370/743)	46.9 (156/333)	45.9 (38.6 – 53.2)	52.2 (214/410)	49.1(42.1 to 56.1)
>$200	17.5 (130/743)	7.8 (26/333)	6.8 (4.2 – 10.9)	25.4 (104/410)	22.3(17.5 to 28.0)

Relationship Status					
Single	69.5(516/742)	69.8(232/332)	66.1 (58.4 – 73.0)	44.8 (184/410)	66.2 (59.0 – 72.7)
Divorced/separated/Widowed	26.3(195/742)	28.6(95/332)	33.0 (26.1 – 40.7)	24.4 (100/410)	28.1(21.8 – 35.4)
Married/Cohabitating/In a relationship	4.2(31/742)	1.5(5/332)	1.0(0.4 – 2.6)	6.3 (26/410)	5.7 (3.5-9.1)
Number of living biological children					
None	36.8(274/744)	32.9(110/334)	37.4 (30.6 – 44.8)	40.0(164/410)	43.7(36.9 – 50.8)
1 child	38.4(286/744)	35.9(120/334)	36.2 (29.3 – 43.8)	40.5(166/410)	36.9(30.5 – 43.8)
≥2 children	24.7(184/744)	31.1(104/334)	26.3 (20.9 – 32.6)	19.5(80/410)	19.4(14.2- 25.9)

BCI= Bootstrapped confidence interval

Table 2: Contraceptive and condom use among female sex workers in Lesotho (n=730)

	Total **% (n/N)**	**Maputsoe** **Crude estimates** **% (n/N)**	**Maseru Crude estimates** **% (n/N)**
Barrier methods of contraception			
Male condom use with new clients Consistent Inconsistent	 64.4(441/685) 35.6(244/685)	 51.5(157/305) 48.5(148/305	 74.7(284/380) 25.3(96/380)
Male condom use with regular clients Consistent Inconsistent	 55.3(382/691) 44.7(309/691)	 44.0(139/316) 56.0(177/316)	 64.8(243/375) 32.2(132/375)
Male condom use with non-paying partners* Consistent Inconsistent	 68.1(190/279) 31.9 (89/279)	 15.7(52/79) 8.1(27/79)	 33.9(138/200) 15.3(62/200)
Non-barrier methods of contraception			

None	54.5(397/729)	43.1(141/327)	63.7(256/402)
Oral pills	9.2(67/730)	9.1(30/328)	9.2(37/402)
Injectable	35.5(259/730)	46.3(152/328)	26.6(107/402)
Intra-Uterine Device	0.8(6/730)	0.61(2/328)	1.0(4/402)
Implants	0.5(4/729)	0.6(2/327)	0.5(2/402)
Surgical methods	0.4(3/730)	0.6(2/328)	0.3(1/402)

*n=459 reported the absence of a non-paying partner.

Table 3: Determinants of engagement in ART care among reproductive age FSW living with HIV not using non-barrier contraceptive methods in Lesotho (n=287)

	Prevalence Ratio (95% Confidence Interval)	p-value	Adjusted Prevalence Ratio (95% Confidence Interval)	p-value
Site				
Maputsoe	Ref		Ref	
Maseru	0.55 (0.40-0.78)	0.001	1.15 (0.72 - 1.83)	0.545
Age, per year	1.07 (1.05 -1.09)	<0.001	1.06 (1.03 - 1.08)	**<0.01**
Monthly income (USD)				
≤100	Ref			
100- <200	1.03(0.68-1.55)	0.877		
≥200	1.07(0.63- 1.79)	0.791		
Relationship status				
Single	Ref		Ref	Ref
Divorced/separated/Widowed	1.80 (1.29- 2.53)	0.001	1.21 (0.83 – 1.76)	0.332
Married/ cohabitating/ in a relationship	1.22 (0.56 - 2.62)	0.616	2.31(1.13 - 4.69)	**0.020**
Number of Children				
No children	Ref		Ref	
1 child	1.82 (1.18 - 2.81)	0.007	2.04 (1.31 – 3.17)	**0.002**
≥2 children	2.26 (1.47 - 3.53)	<0.001	1.41 (0.91 - 2.19)	0.117
Education level completed				
No schooling	2.35(1.43 - 3.84)	0.001	1.83(1.13 - 2.95)	**0.013**

Primary school	1.82 (1.20 - 2.77)	0.005	1.90 (1.28 - 2.82)	**0.001**
Secondary education	Ref		Ref	
Sex work disclosure to healthcare worker				
Not disclosed	Ref			
Yes	1.18 (0.84 - 1.66)	0.332		
HIV Status disclosure to non-paying partners (NPP)				
No NPP	Ref		Ref	
Not disclosed HIV status to NPP	0.15(0.04 - 0.59)	0.007	0.24 (0.04 - 1.49)	0.128
Disclosed HIV status to some or all NPP	0.88 (0.62 - 1.25)	0.490	0.96(0.63 - 1.47)	0.878
Alcohol use frequency on a typical working day				
Do not drink alcohol	Ref		Ref	
1-4 drinks	0.83(0.53 - 1.30)	0.423	0.88(0.55 - 1.40)	0.592
≥5 drinks	0.56(0.40 - 0.84)	0.003	0.59(0.40 - 0.87)	**0.008**
Ever incarcerated				
No	Ref			
Yes	1.12(0.73 - 1.72)	0.578		
Received HIV related education/ information in past 12 months				
No	Ref		Ref	
Yes	4.36 (1.99 - 9.54)	<0.001	2.62(1.25 - 5.46)	**0.010**
Future pregnancy intentions				
No	Ref		Ref	
Yes	0.60 (0.40 - 0.90)	0.014	1.42(0.96 – 2.12)	0.081

Depressive symptoms				
Minimal depressive symptoms	Ref			
5-14: Mild/Moderate depressive symptoms	0.77(0.54 - 1.10)	0.156		
>14: Moderate/Severe depressive symptoms	0.67(0.36 - 1.23)	0.199		
Afraid to go to clinic because you are worried they would know you sell sex?				
No	Ref		Ref	
Yes	0.53 (0.26 - 1.04)	0.068	0.76 (0.37 - 1.56)	0.464
Avoid going to clinic because someone may learn you sell sex?				
No	Ref			
Yes	0.53 (0.23 - 1.19)	0.128		
Denied healthcare because you sell sex?				
No	Ref		Ref	
Yes	2.13 (1.18 - 3.85)	0.012	2.52 (0.97 – 5.75)	**0.027**
Ever experienced physical abuse				
No	Ref		Ref	
Yes	0.62(0.43 - 0.86)	0.006	0.94(0.61 - 1.43)	0.785
Police harassed you because you sell sex?				
No	Ref		Ref	
Yes	0.66 (0.45 - 0.94)	0.025	0.85(0.54 - 1.36)	0.515

Table 4: Sensitivity Analysis

Determinants of ART use among female sex workers (age 18-49) not using non-barrier contraceptive methods who are living with HIV and aware of their HIV status (n=175)

	Adjusted Prevalence Ratio (95% Confidence Interval)	**p-value**
Site		
Maputsoe	Ref	
Maseru	1.07 (0.71 - 1.60)	0.746
Age, per year	1.03 (1.00 - 1.05)	**0.001**
Monthly income (USD)		
≤100		
100-<200		
>200		
Relationship status		
Single	Ref	
Divorced/separated/Widowed	1.01(0.82 - 1.55)	0.977
Married/cohabitating/ in a relationship	2.11(1.17 – 3.83)	**0.013**
Number of Children		
No children	Ref	
1 child	1.42 (0.97 - 2.08)	0.071
≥2 children	1.23(0.86 – 1.76)	0.247
Education level completed		
No schooling	1.62 (1.09 - 2.42)	**0.017**
Primary school	1.76(1.24 - 2.49)	**0.001**

Secondary education	Ref	
HIV Status disclosure to non-paying partners (NPP)		
No NPP	Ref	
Not disclosed HIV status to NPP	0.25 (0.04 – 1.47)	0.126
Disclosed HIV status to some or all NPP (versus No NPP_	0.75 (0.50 - 1.13)	0.179
Alcohol use frequency on a typical working day		
Do not drink alcohol	Ref	
1-4 drinks	0.78 (0.52 - 1.16)	0.223
≥5 drinks	0.63 (0.45 - 0.86)	**0.005**
Received HIV related education/ information in past 12 months		
No	Ref	
Yes	1.87 (1.07 – 2.09)	0.070
Future pregnancy intentions		
No	Ref	
Yes	1.50(1.07 – 2.09)	**0.016**
Afraid to go to clinic because you are worried they would know you sell sex?		
No	Ref	
Yes	0.83 (0.44 - 1.57)	0.574
Denied healthcare because		

you sell sex?		
No	Ref	
Yes	2.18 (0.96 – 4.95)	0.063
Physical abuse		
No	Ref	
Yes, experienced	1.01(0.71 – 1.46)	0.992
Police harassed you because you sell sex?		
No	Ref	
Yes	0.92(0.59 - 1.40)	0.685

Figure 2: Conceptual Framework outlining the risk factors affecting engagement in HIV care

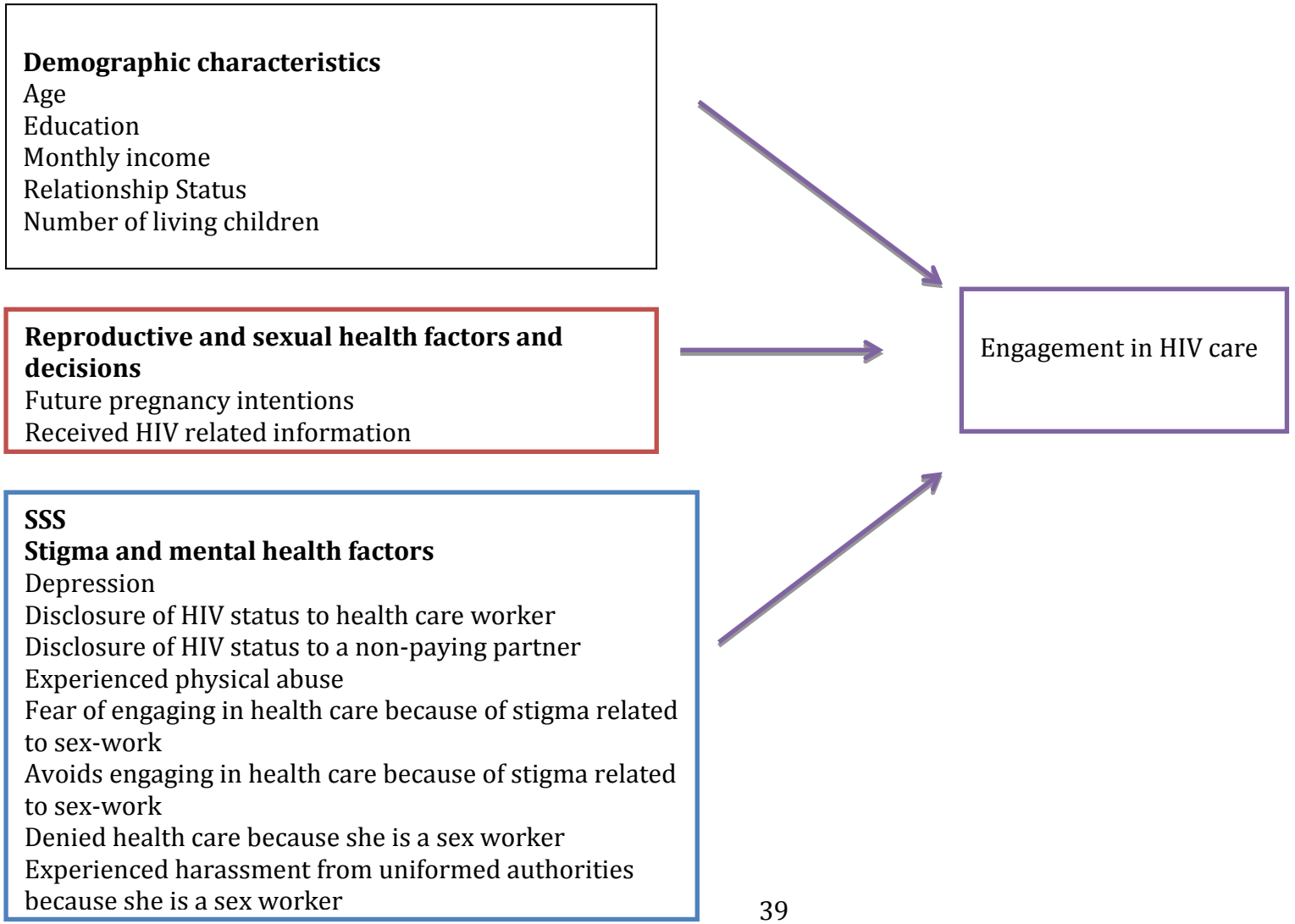


Figure 3: Recruitment networks among FSW in Lesotho, 2014 (n=744)

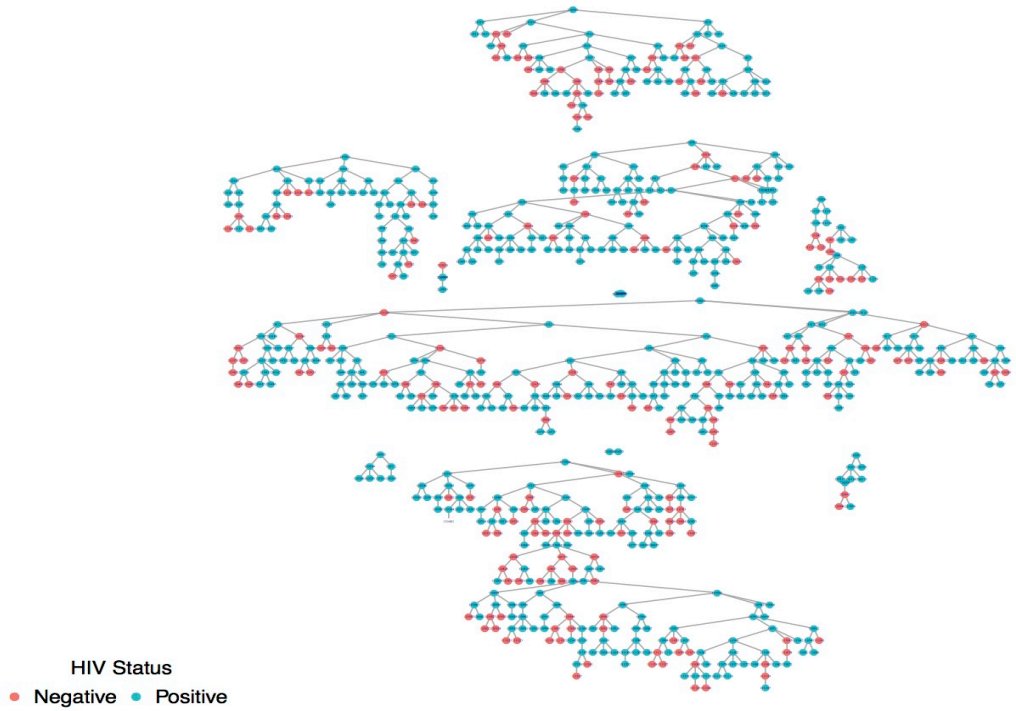
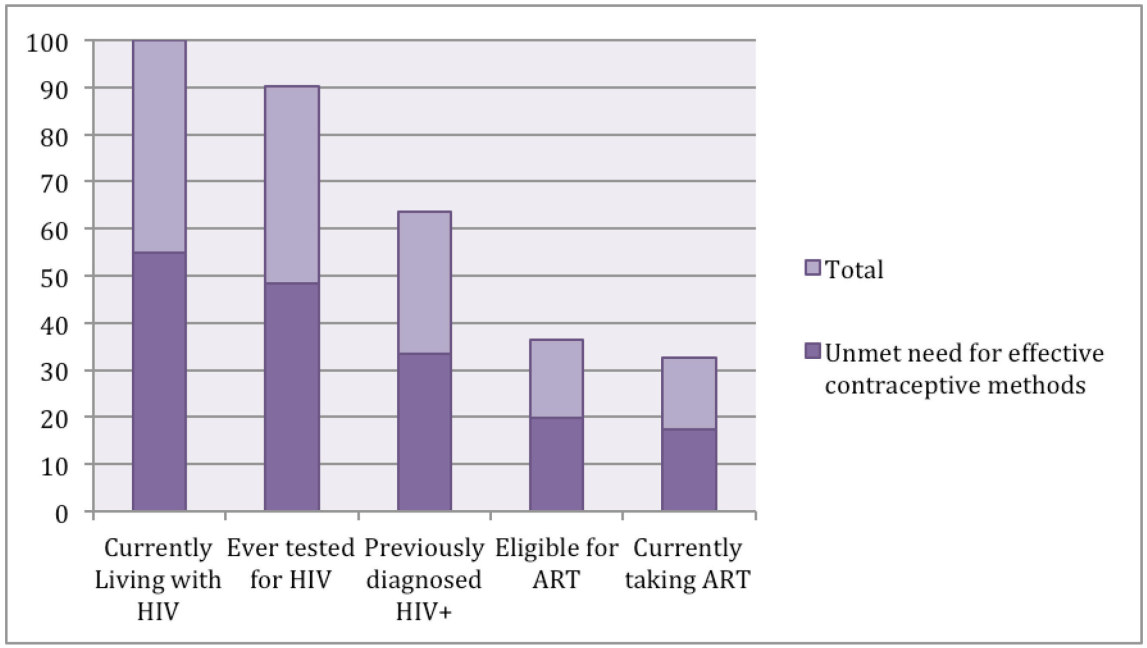


Figure 4: Engagement of FSW in the HIV care cascade, Lesotho 2014



Engagement in HIV care among all sex workers in the study sample and within a sub sample of FSW with unmet contraceptive need.
ART: Antiretroviral therapy

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REFERENCES

1. Darroch JE, Singh S. Trends in contraceptive need and use in developing countries in 2003, 2008, and 2012: an analysis of national surveys. The Lancet. 2013 May 18;381(9879):1756–62.
2. Baral S, Phaswana-Mafuya N. Rewriting the narrative of the epidemiology of HIV in sub-Saharan Africa. SAHARA J J Soc Asp HIVAIDS Res Alliance. 2012;9(3):127–30.
3. Schwartz SR, Papworth E, Ky-Zerbo O, Sithole B, Anato S, Grosso A, et al. Reproductive health needs of female sex workers and opportunities for enhanced prevention of mother-to-child transmission efforts in sub-Saharan Africa. J Fam Plann Reprod Health Care. 2015 Nov 25;jfprhc– 2014–100968.
4. IndexMundi. Deatiled country Statistics. Retrieved from http://positive.indexmundi.com/factbook/compare/lesotho.united-states
5. Find the data. Graphiq. Retrieved from http://country-facts.findthedata.com/compare/1-41/United-States-vs-Lesotho
6. Central Intelligence Agency. World Factbook. Retrieved from https://positive.cia.gov/library/publications/the-world-factbook/geos/lt.html)
7. Ministry Of Health. Global AIDS Response Progress Report 2015, Lesotho Country report. 2015
8. Government of Lesotho. Lesotho HIV Prevention Response and Modes of Transmission Analysis. Maseru, Lesotho: Government of Lesotho. 2009
9. Ngugi EN, Roth E, Mastin T, Nderitu MG, Yasmin S. Female sex workers in Africa: Epidemiology overview, data gaps, ways forward. SAHARA J J Soc

Asp HIVAIDS Res Alliance SAHARA Hum Sci Res Counc. 2012;9(3):148–53.

10. Ministry of Health and Social Welfare (Lesotho) & ICF Macro (2010). Lesotho Demographic and Health Survey 2009. Maseru, Lesotho: MOHSW & ICF Macro.

11. Baral S, Beyrer C, Muessig K, Poteat T, Wirtz AL, Decker MR, et al. Burden of HIV among female sex workers in low-income and middle-income countries: a systematic review and meta-analysis. Lancet Infect Dis. 2012 Jul;12(7):538–49.

12. Dunkle KL, Beksinska ME, Rees VH, Ballard RC, Htun Y, Wilson ML. Risk factors for HIV infection among sex workers in Johannesburg, South Africa. Int J STD AIDS. 2005 Mar;16(3):256–61.

13. Baral S, Logie CH, Grosso A, Wirtz AL, Beyrer C. Modified social ecological model: a tool to guide the assessment of the risks and risk contexts of HIV epidemics. BMC Public Health. 2013;13:482.

14. Sweitzer S, Rolfe J, Ketende S, Grosso A, Baral S. Examining Factors Associated with HIV-Related Risk Behaviors,HIV Prevalence, and Population Size Estimatesof Two Key Populations—Men who have Sex with Men (MSM) and Female Sex Workers (FSW)—in Lesotho.January 2015.Baltimore: USAID.

15. Shannon K, Strathdee SA, Shoveller J, Rusch M, Kerr T, Tyndall MW. Structural and Environmental Barriers to Condom Use Negotiation With Clients Among Female Sex Workers: Implications for HIV-Prevention Strategies and Policy. Am J Public Health. 2009 Apr;99(4):659–65.

16. Ministry of Health [Lesotho], ICF International. 2016. Lesotho Demographic and Health Survey 2014. Maseru, Lesotho: Ministry of Health and ICF International.
17. MEASURE Evaluation Project, Tulane University Sechaba Consultants, Lesotho CARE, Lesotho. Sexual Violence against women. 2004
18. Baleta A. Lives on the line: sex work in sub-Saharan Africa. Lancet Lond Engl. 2015 Jan 3;385(9962):e1–2.
19. United States Department of State. Lesotho Country Operational Plan (COP) 2015 Strategic Direction Summary. 2015 August.
20. Ministry of Health, Government of Lesotho, United Nations System in Lesotho. MDG ACCELERATION FRAMEWORK Improving Maternal Health. October 2013.
21. World Health Organization. PMTCT Strategic Vision: 2010– 2015. Preventing Mother-to-Child Transmission of HIV to reach the UNGASS and Millennium Development Goals. 2010. http://www.who.int/hiv/pub/mtct/strategic_vision/en/ [accessed 2 April 2014].
22. Geldsetzer P, Yapa HMN, Vaikath M, Ogbuoji O, Fox MP, Essajee SM, et al. A systematic review of interventions to improve postpartum retention of women in PMTCT and ART care. J Int AIDS Soc [Internet]. 2016 Apr 25 [cited 2017 Mar 20];19(1). Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846797/
23. Dhana A, Luchters S, Moore L, Lafort Y, Roy A, Scorgie F, et al. Systematic review of facility-based sexual and reproductive health services for female sex workers in Africa. Glob Health. 2014;10:46.

24. Papworth E, Schwartz S, Ky-Zerbo O, Leistman B, Ouedraogo G, Samadoulougou C, et al. Mothers who sell sex: a potential paradigm for integrated HIV, sexual, and reproductive health interventions among women at high risk of HIV in Burkina Faso. J Acquir Immune Defic Syndr 1999. 2015 Mar 1;68 Suppl 2:S154–61.

25. Heckathorn DD. Respondent-driven sampling: a new approach to the study of hidden populations. Soc Probl 1997;44:174–99.

26. StataCorp. 2015. *Stata Statistical Software: Release 14*. College Station, TX: StataCorp LP.

27. OANDA. Historical exchange rates. 2009; Available from: http://www.oanda.com/currency/historical-rates/.

28. The World Bank. Understanding Poverty. 2015 Retrieved from http://www.worldbank.org/en/topic/poverty/brief/global-poverty-line-faq

29. Cowan FM, Mtetwa S, Davey C, Fearon E, Dirawo J, Wong-Gruenwald R, et al. Engagement with HIV Prevention Treatment and Care among Female Sex Workers in Zimbabwe: a Respondent Driven Sampling Survey. PLOS ONE. 2013 Oct 15;8(10):e77080.

30. Lancaster KE, Powers KA, Lungu T, Mmodzi P, Hosseinipour MC, Chadwick K, et al. The HIV Care Continuum among Female Sex Workers: A Key Population in Lilongwe, Malawi. PloS One. 2016;11(1):e0147662.

31. Schwartz S, Lambert A, Phaswana-Mafuya N, Kose Z, Mcingana M, Holland C, et al. Engagement in the HIV care cascade and barriers to antiretroviral therapy uptake among female sex workers in Port Elizabeth, South Africa: findings from a respondent-driven sampling study. Sex Transm Infect. 2016 Nov 25;

32. Becker M, Ramanaik S, Halli S, Blanchard JF, Raghavendra T, Bhattacharjee P, et al. The Intersection between Sex Work and Reproductive Health in Northern Karnataka, India: Identifying Gaps and Opportunities in the Context of HIV Prevention. AIDS Res Treat. 2012 Dec 30;2012:e842576.
33. Decker MR, Yam EA, Wirtz AL, Baral SD, Peryshkina A, Mogilnyi V, et al. Induced abortion, contraceptive use, and dual protection among female sex workers in Moscow, Russia. Int J Gynaecol Obstet Off Organ Int Fed Gynaecol Obstet. 2013 Jan;120(1):27–31.
34. Sutherland EG, Alaii J, Tsui S, Luchters S, Okal J, King'ola N, et al. Contraceptive needs of female sex workers in Kenya - a cross-sectional study. Eur J Contracept Reprod Health Care Off J Eur Soc Contracept. 2011 Jun;16(3):173–82.
35. Agadjanian V, Hayford SR. HIV status, fertility intentions, and contraception in the era of expanded access to antiretroviral therapy: A case study of rural Mozambique. Glob Public Health. 2016 Dec 29;0(0):1–15.
36. Makumbi FE, Nakigozi G, Reynolds SJ, Ndyanabo A, Lutalo T, Serwada D, et al. Associations between HIV Antiretroviral Therapy and the Prevalence and Incidence of Pregnancy in Rakai, Uganda. AIDS Res Treat. 2011 Jan 19;2011:e519492.
37. PRESS RELEASE [Internet]. United Nations in Lesotho. 2016 [cited 2017 Apr 18]. Available from: http://www.unlesotho.org/press-release-4/
38. Nansseu JRN, Bigna JJR. Antiretroviral therapy related adverse effects: Can sub-Saharan Africa cope with the new "test and treat" policy of the World Health Organization? Infect Dis Poverty [Internet]. 2017 Feb 15 [cited 2017

Apr 3];6. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5310075/

39. Stinson K, Jennings K, Myer L. Integration of Antiretroviral Therapy Services into Antenatal Care Increases Treatment Initiation during Pregnancy: A Cohort Study. PLOS ONE. 2013 May 16;8(5):e63328.
40. Weigel R, Hosseinipour MC, Feldacker C, Gareta D, Tweya H, Chiwoko J, et al. Ensuring HIV-infected pregnant women start antiretroviral treatment: an operational cohort study from Lilongwe, Malawi. Trop Med Int Health. 2012 Jun 1;17(6):751–9.
41. Odili VU, Obieche AO, Amibor KC. Adherence to Antiretroviral Therapy and Its Determinants Among HIV-Infected Patients in Nigeria. J Pharm Pract. 2016 Feb 25;
42. Kleinman NJ, Manhart LE, Mohanraj R, Kumar S, Jeyaseelan L, Rao D, et al. Antiretroviral therapy adherence measurement in non-clinical settings in South India. AIDS Care. 2015;27(2):248–54.
43. Peltzer K, Pengpid S. Socioeconomic Factors in Adherence to HIV Therapy in Low- and Middle-income Countries. J Health Popul Nutr. 2013 Jun;31(2):150–70.
44. Falagas ME, Zarkadoulia EA, Pliatsika PA, Panos G. Socioeconomic status (SES) as a determinant of adherence to treatment in HIV infected patients: a systematic review of the literature. Retrovirology. 2008;5:13.
45. Schneider M, Chersich M, Temmerman M, Degomme O, Parry CD. The impact of alcohol on HIV prevention and treatment for South Africans in primary healthcare. Curationis. 2014 Aug 1;37(1):1137.

46. Cottonham DP, Madson MB, Nicholson BC, Mohn RS. Harmful alcohol use and alcohol-related sex expectancies as predictors of risky sex among african american female college drinkers. J Ethn Subst Abuse. 2017 Feb 6;1–12.
47. Iakunchykova OP, Burlaka V. Correlates of HIV and Inconsistent Condom Use Among Female Sex Workers in Ukraine. AIDS Behav. 2016 Jul 25;
48. Konate I, Traore L, Ouedraogo A, Sanon A, Diallo R, Ouedraogo J-L, et al. Linking HIV prevention and care for community interventions among high-risk women in Burkina Faso--the ARNS 1222 "Yerelon" cohort. J Acquir Immune Defic Syndr 1999. 2011 Jul 1;57 Suppl 1:S50–4.
49. Govindasamy D, Meghij J, Kebede Negussi E, Clare Baggaley R, Ford N, Kranzer K. Interventions to improve or facilitate linkage to or retention in pre-ART (HIV) care and initiation of ART in low- and middle-income settings--a systematic review. J Int AIDS Soc. 2014;17:19032.
50. Mmbaga EJ, Leyna GH, Ezekiel MJ, Kakoko DC. Fertility desire and intention of people living with HIV/AIDS in Tanzania: a call for restructuring care and treatment services. BMC Public Health. 2013;13:86.
51. Haskins LJ, Phakathi SP, Grant M, Mntambo N, Wilford A, Horwood CM. Fragmentation of maternal, child and HIV services: A missed opportunity to provide comprehensive care. Afr J Prim Health Care Fam Med. 2016 Dec 2;8(1):8 pages

CURRICULUM VITAE

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EDUCATION

ScM Infectious Diseases Epidemiology **Sep '15 - May '17 (expected)**
Johns Hopkins Bloomberg School of Public Health, Baltimore MD, USA

Graduate research: Unmet HIV Treatment Needs to Prevent Vertical Transmission of HIV among Female Sex Workers in Lesotho.
Thesis Supervisors: Drs. Stefan Baral and Sheree Schwartz, Department of Epidemiology

MSc Infectious Diseases, Drug Discovery and Vaccinology **Sep '11-Mar '13**
Joint educational collaboration between Biozentrum University of Basel, Swiss Tropical and Public Health Institute, National University of Singapore and the Novartis Institute of Tropical Diseases

Graduate Research: Characterization of drug induced cell death in *Mycobacterium smegmatis*

Bachelor of Engineering, Biotechnology **June '07 – June '11**
Sri Jayachamarajendra College of Engineering, Mysore, India

Undergraduate Research: Role of membrane binding proteins in kidney stone formation and their inhibition

PUBLIC HEALTH RESEARCH EXPERIENCE

Research Assistant, Centre for Public Health and Human Rights **Jun '16 – Present**
Johns Hopkins Bloomberg School of Public Health (JHSPH)

- Conducting quality control and qualitative assurance of data from observational studies across Africa using STATA.
- Performing qualitative data analysis of in-depth interviews of Female Sex Workers (FSWs) and Peer Educators using ATLAS.ti
- Assessing scientific manuscript quality for peer review and publication for journals.
- Building statistical models to investigate factors influencing the use of Anti-retroviral therapy among FSWs in Lesotho & assess the risks of vertical transmission of HIV. This study is currently in the process of scientific manuscript development for peer review and publication.

Global Health Field Placement Award, Centre for Global Health **June '16 - Oct'16**
Johns Hopkins Bloomberg School of Public Health

On site collaborator: TB/HIV Care Association (THCA), Port Elizabeth, South Africa
THCA is a registered non-profit based in South Africa, and their office in Port Elizabeth is exclusively dedicated to programmatic interventions to increase HIV/STI testing and treatment outcomes among female sex workers.

- Awarded a travel grant of $3500 to conduct research and programmatic activities in developing countries.
- Monitored data quality and executed data cleaning and data management activities using EpiData and STATA.
- Orchestrated the conduction of in-depth interview transcription and translation, and subsequently developed codebooks to analyze data using ATLAS.ti
- Coordinated on-site activities through strategic planning with off-site team based in the USA to enable efficient and seamless integration of research and programmatic activities.
- Drafted protocol applications to Institutional Review Boards for future research projects.

Research Assistant, Department of Epidemiology **Dec '15 - July '16**
Johns Hopkins Bloomberg School of Public Health

- Conducted abstract screening of over 4500 scientific publications using DistillerSR
- Subsequently performed full text review and data abstraction of over 650 publications for a large systematic review assessing Human Influenza A titers across age groups and distributions.

Intern **May '15 - July'15**
Action For AIDS, Singapore| *A Singapore based Non-Profit*.

- Delivered HIV testing and counseling services to the Singaporean community through Mobile Clinic Services
- Initiated the development of new fundraising and community awareness projects for HIV.

Clinical Research Associate, Department of Cardiology **Dec '13 – Nov '14**
Cardiac Clinical Trials and Research Unit, SRM Medical College Hospital and Research Centre (SRMMCH & RC), Chennai, India

- Executed cross sectional, prospective/ longitudinal and pilot clinical trial studies through systematic patient screening, recruitment and follow-up.
- Co-authored manuscripts published in high impact peer review journals.
- Conducted data management activities including data entry and quality control
- Performed data analysis using statistical software package SPSS.

Research Associate **July '13 - Oct '13**
Helix2Health, Start-up reproductive genomics company, Singapore

- Assisted in writing research grants and proposals
- Assisted in the compiling 150 single gene disorders with high frequency in Asian populations that could be included in a generic panel for carrier screening

TEACHING EXPERIENCE

Teaching Assistant, Epidemiologic Inference in Outbreak Investigations
JHSPH Epidemiology Department

PUBLICATIONS

- George, M., Jena A., **Srivatsan, V.,** Rajaram, M., Dhandapani, V. E. (2016) GDF-15- A novel biomarker in the offing of heart failure. *Current Cardiology Reviews*. 12: 37-46

- **Srivatsan, V.,** George, M., Dhandapani, V. E. (2015) Omentin: A Novel Biomarker in Cardiovascular Disease. *Journal of Cardiovascular Medicine and Surgery*.1 (1): 33-44

- George, M., Shanmugam, E., **Srivatsan, V.,** Vasanth, K., Ramraj, B., Rajaram, M., Jena, A., Sridhar, A., Chaudhury, M., Kaliappan, I. (2015). Value of Pentraxin-3 and Galectin-3 in Acute Coronary Syndrome- A short term prospective study. *Therapeutic Advances in Cardiovascular Disease.* Advance online publication. doi:10.1177/1753944715578405

- **Srivatsan, V.**, George, M., & Shanmugam, E. (2014) Utility of galectin-3 as a prognostic biomarker in heart failure: Where do we stand? *European Journal of Preventive Cardiology*. Advance online publication. doi: 10.1177/2047487314552797

MANUSCRIPTS IN PREPARATION

- **Srivatsan, V**., Schwatrz, S., Sweitzer, S., Mothopeng, T., Mpooa, N., N, Taruberekera., Baral S. Unmet HIV Treatment Needs to Prevent Vertical Transmission of HIV among Female Sex Workers in Lesotho